

~~Sub 11/13~~
N. (New) A process for producing foamed polyisocyanate polyaddition products or polyurethane elastomers by reacting:

- 2,
cancel
- a) isocyanates with
 - b) compounds which are reactive toward isocyanates in the presence of
 - c) at least one organic or inorganic acid anhydride;
 - d) at least one urethane-forming catalyst different from b);
 - e) optionally, blowing agents, additives and/or auxiliaries.

16 N2. (New) The foamed polyisocyanate polyaddition products or polyurethane elastomers made according to the process of claim 1, comprising unreacted organic or inorganic acid anhydride.

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REMARKS

Claims 1-4 are currently pending in this application. Upon entry of this amendment, claims 1-12 are pending, claims 1, 9, 10 and 11 are independent claims. Support for new claims 7-12 is found throughout the specification, in particular page 4, line 36-39; page 5, line 38-45 and page 12, line 29-45 through page 13, line 1-9. No new matter has been added.

Claims 1-4 were rejected under 35 USC §102 as anticipated by Smith (U.S. Patent No. 5,422,414). The '414 patent is directed to RIM products, based on aminic polyols, formed "in the absence of a urethane forming catalyst." (U.S. Patent No. 5,422,414 Col. 5, lines 65-66.) In a telephonic interview, the Examiner clarified the rejection, stating that although the aminic polyols of Smith are reactants, these polyols are considered to have catalytic activity. The Examiner identified several alkanolamine catalysts recited by Applicant as being potential reactants in the polyurethane forming reaction. As amended, claim 1, and its dependent claims, are directed to a

process requiring at least one catalyst selected from organic amines, excluding alkanolamines, and organic metal compounds. The catalyst recited in Claim 1 is neither taught nor suggested by the '414 patent, which teaches against use of a urethane forming catalyst.

The '414 patent also fails to teach or suggest claim 11's process for producing foamed polyisocyanate polyaddition products or polyurethane elastomers by reacting a) isocyanates with b) compounds which are reactive toward isocyanates in the presence of c) at least one organic or inorganic acid anhydride and d) at least one urethane-forming catalyst different from b).

Likewise, claims 7 and 12 are not anticipated where there is no teaching or suggestion that the reaction products of the '414 patent's process contain unreacted acid anhydride. The '414 process solves the problem of regulating reaction time by reacting a particular isocyanate component, a polyol component and a carboxylic anhydride. (U.S. Patent No. 5,422,414, Col. 3, lines 30-43.) The '414 patent fails to teach or suggest that unreacted anhydride is present in the '414 products. The presence of unreacted anhydride cannot be considered inherent in the '414 products, where anhydride is taught as a reactant and where the '414 reactants and end products are different from Applicants' combination.

Claims 9 and 10 are directed to products which are neither taught nor suggested by the '414 patent. Claim 9 is directed to flexible polyurethane foam having a density of 20 to 70 kg/m³ comprising at least one organic or inorganic acid anhydride. Claim 10 is directed to various products comprising flexible polyurethane foam having a density of 15 to 300 kg/m³ wherein said foam comprises at least one organic or inorganic acid anhydride. The '414 patent is directed to RIM products. It is well known in the art that the density of RIM products is approximately 1000 kg/m³, see R. Leppkes, Polyurethanes, pp. 56-57 (1995), attached. There is no teaching or suggestion to change the RIM system of the '414 patent to make flexible foam having density in the

15 to 300 kg/m³ range and even if the '414 system were modified, it would not achieve Applicants' invention.

Based on the foregoing remarks, Applicants respectfully submit that they have overcome the Examiner's rejections, and that the claims are in a condition suitable for allowance. A Notice to that effect is respectfully solicited. Should the Examiner have any questions, please contact the undersigned attorney.

Respectfully submitted,



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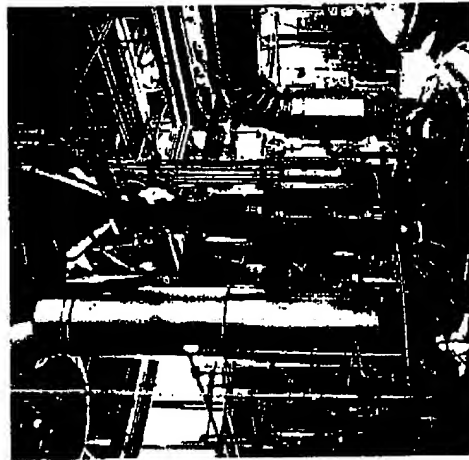
APPENDIX A - Amended Claim

1. A process for producing foamed polyisocyanate polyaddition products or polyurethane elastomers by reacting isocyanates with compounds which are reactive toward isocyanates in the presence of catalysts, blowing agents, additives and/or auxiliaries, wherein the reaction is carried out in the presence of (ii) at least one organic or inorganic acid anhydride and at least one catalyst selected from the group consisting of organic amines, excluding alkanolamines, and organic metal compounds.

Polyurethanes

Materials with many faces

Reinhard Leppkes



verlag moderne industrie

56 RIM materials in automotive applications

Fig. 44:
Windshield sealing
strip made from PU-
RIM (reaction injec-
tion molding)



RIM material has a density of around 1000 kg/m³ and is thus virtually solid. It is tough and resilient and more or less rigid with a high elongation at break and impact strength (table 6). Because of their high reactivity, RIM systems are processed almost always on high-pressure metering units. In mass production, heated molds made of steel, aluminum or synthetic resin are used.

The isocyanates used are difunctional prepolymers based on MDI. Through the reaction with long-chain polyols (molecular weights 4000 to 6000 g/mol), soft segments are obtained which impart elasticity, toughness and elongation to the end product. The rigidity, hardness and heat distortion resistance of the molded parts are influenced by the hard segments which are formed from the reaction with difunctional, short-chain polyols, the chain extenders. The ratio of hard to soft segments determines the overall property profile and particularly the impact strength.

A distinction can be made between the following RIM systems:

- *Conventional RIM*: Diols such as ethylene glycol or butanediol are used as chain ex-

RIM materials in automotive applications 57

Mechanical property	Unit	Low-speed RIM	Standard RIM	High-speed RIM and easy-release RIM long, trans. long, trans.
Mass fiber content	%	—	—	0 10 20
Max. injection time	s	10	5	1.3 1.3 1.3
Min. demold time	s	60	60	20 20 20
Density DIN 53420	g/cm ³	1.08	1.05	1.1 1.17 1.25
Shore D hardness		60	60	55 57 62
DIN 53505				
Tensile strength	N/mm ²	20	24	23 25 23.5 26 25
bar S-2 DIN 53504				
Elongation at break	%	70	180	300 260 280 200 240
bar S-2 DIN 53504				
bar propagation resistance	N/mm	23	27	30 34.5 32.5 35.5 37
DIN 53507				
Heat distortion temperature method B DIN 53461	°C	70	110	120 130 — 185 —
Coefficient of thermal expansion from -20 °C to +120 °C	10 ⁻³ /K	18	18	16 5.3 13 3.5 11.5
DIN 53752				
Shrinkage, linear measured on sheets	%	1.3	1.3	1.5 0.95 1.3 0.4 1.1
Flexural modulus at +23 °C	N/mm ²	600	600	480 870 510 1360 850
DIN 53457				
Impact strength at +25 °C small-size steel test bar DIN 53453				

tenders. The hardness values of conventional RIM are in the Shore A 60 to D 70 range. The injection times (3 to 10 seconds) and demold times (at least 60 seconds) are comparatively long, but on the other hand, complicated parts with long flow paths and small or varying cross-sections can be produced.

An important example of conventional RIM is window encapsulation. The PU is molded around the window in the RIM process and the encapsulated window is supplied as a finished unit. The unit can be installed or bonded in place by machine or by a simple manual operation. Window encapsulation based on aliphatic isocyanate is used in the US in fairly large volume.

Table 6:
Properties of RIM systems (values measured on post-cured test sheets, 4 mm thick)

Typical application – window encapsulation